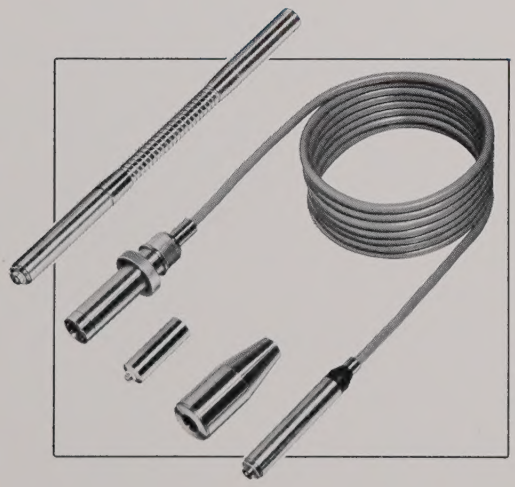
2619

Instructions and Applications



Preamplifier Type 2619 for 1" and 1/2" Condenser Microphones

A field effect transistor preamplifier for the full range of B & K microphone cartridges. The extremely high input impedance presents virtually no load to the microphone, ensuring a flat overall frequency response and wide dynamic range. Operates from 120 V DC or 28 V DC supply.

BRÜEL & KJÆR

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1. INTRODUCTION

1.1 GENERAL

The 1/2" Preamplifier Type 2619 is designed especially for use with the B&K condenser microphone cartridges. It features a very high input impedance field-effect-transistor input, which presents virtually no load to the microphone cartridge. This gives the combination a wide frequency range of 2 Hz–200 kHz, and a wide dynamic range with a lower limit of 36 dB re 2×10^{-5} N/m^2 for the 1/2" microphone.

The preamplifier can be operated from a 120 V DC supply, such as the condenser microphone input of the B&K microphone amplifiers, or from a 28 V DC supply, with slightly different specifications. A heater coil is built into the tip of the preamplifier to eliminate moisture in the microphone under conditions of high relative humidity.

Accessories included are: a gooseneck UA 0196 to facilitate measurements in high temperature (150°C) by taking the preamplifier away from the transducer, and for providing directional flexibility for the microphone, an adapter JJ 2615 for the connection of miniature cables such as from an accelerometer, and containing a 50 pF capacitor to block the polarization voltage, and an adapter for 1" microphone cartridges, DB 0375.

1.2 PREAMPLIFIER REQUIREMENTS

When a capacitive type transducer such as a condenser microphone, or a piezoelectric accelerometer is used for measuring purposes, it normally must be connected to a high impedance, to preserve the low level signal. This is because the capacitance associated with the transducer is very small, and the capacitance of even fairly short cable lengths can load the transducer to seriously reduce the signal appearing at the other end of the cable. An equivalent circuit diagram of a microphone and preamplifier input circuit is shown in Fig.1.1a.

Here $j\omega C_T v_o$ = current supplied by the transducer
v_o = open circuit voltage of the transducer
C_T = transducer capacitance
C_c = cable capacitance
C_p = preamplifier input capacitance
R = preamplifier input resistance

This circuit can be further reduced to Fig.1.1b where

$$C = C_T + C_c + C_p$$

The voltage v across the preamplifier input can be calculated from

$$v = \frac{j\omega C_T V_o}{j\omega C + \frac{1}{R}}$$

Thus the transmission ratio is

$$\frac{v}{v_o} = \frac{C_T}{C} \frac{j\omega RC}{1 + j\omega RC}$$

At high frequencies $j\omega RC \gg 1$ so

$$\frac{v}{v_o} = \frac{C_T}{C}$$

This means that the transmission ratio is independent of frequency but depends on the total capacitance loading of the microphone. It is therefore desirable to reduce this loading as much as possible in order to achieve the highest possible signal to noise ratio. Usually the cable capacitance is avoided altogether by screwing the microphone direct onto the preamplifier.

At low frequencies $j\omega RC \ll 1$ so

$$\frac{v}{v_o} = \frac{C_T}{C} \quad j\omega RC$$

giving a drop of six dB per octave as frequency decreases.

The cut–off frequency, –3 dB point, is where $\omega RC = 1$ or

$$f = \frac{1}{2\pi RC}$$

The cut–off is determined by the combination of preamplifier resistance and the total capacitance. A low cut–off frequency could be obtained by putting in a large capacitance, but as this would mean seriously reduced signal strength it is necessary to keep C as small as possible and strive for the highest possible preamplifier input resistance.

HALF–INCH
PREAMPLIFIER FOR CONDENSER MICROPHONES
TYPE 2619

February 1971

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The preamplifier 2619 has an input capacitance of approx. 0.7 pF and a resistance of 4 G Ω at 20°C. This gives a loss of voltage of only 0.3 dB for a 1/2" microphone. The calculated cut–off frequency is 2 Hz, and this is about the same as the mechanical cut–off of the microphone due to the pressure equalization.

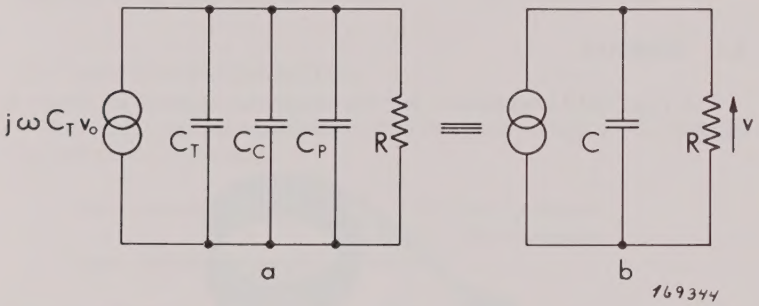

Fig. 1.1a. Equivalent circuit for microphone and preamplifier input cicuit.
Fig. 1.1b. Simplified equivalent circuit

2. DESCRIPTION

2.1 GENERAL

The Type 2619 preamplifier and the accessories supplied are shown in Fig.2.1.

Fig.2.1. The Type 2619 Preamplifier with the Accessories supplied.

The accessories are:—

DB 0375 — screw thread adapter for 1" microphone cartridges.
JJ 2615 — coaxial input plug adapter for miniature cables.
UA 0196 — flexible gooseneck extension

Adapters UA 0035 for 1/4" cartridges, and UA 0036 for 1/8" cartridges are also available.

The preamplifier without adapters takes 1/2" microphone cartridges directly. Thus the Type 2619 is a universal microphone preamplifier, covering the whole range of B&K condenser microphones. A heating coil is built into

the microphone end of the preamplifier to prevent condensation in the cartridge and on the insulators. The other end of the preamplifier plugs into the CONDENSER MICROPHONE input of the B&K microphone amplifiers, etc., or into the microphone power supplies, extension cables, etc.

The preamplifier will also operate on 28 V, 120 V, or 200 V DC supplies, making it a very flexible unit.

2.2 INPUT CHARACTERISTICS

The input impedance depends on the operating voltage of the preamplifier and on the temperature.

Input resistance:	>4 GΩ, 120 V operation
	>2.6 GΩ, 28 V operation
Input capacitance approx.	0.7–0.9 pF

The input impedance of the preamplifier varies typically with temperature as shown in Fig.2.2, but is still larger than 3 GΩ at 60°C.

Maximum input voltage:	32 V RMS (sine) 120 V supply
	4 V RMS (sine) 28 V supply

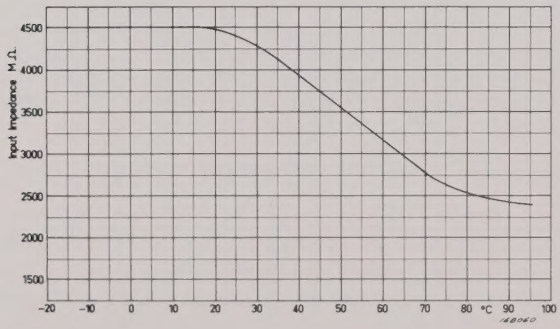

Fig.2.2. Typical variation of input impedance with temperature.

2.3 OUTPUT CHARACTERISTICS

The output characteristics are also dependent on the operating voltage.

Output impedance:	$< 25\,\Omega$, 120 V operation
	$< 70\,\Omega$, 28 V operation
Maximum output voltage:	32 V RMS 120 V operation
	4 V RMS 28 V operation
Maximum output current:	1.5 mA peak 120 V operation
	0.5 mA peak 28 V operation

If these figures are exceeded, clipping of the signal occurs, and distortion is introduced. When the load on the amplifier is capacitive, the capacitive current increases with frequency for a given voltage. This effect means that distortion can arise at high frequencies when very long cables, with high capacitance, are connected to the output. The effect is usually not noticed, for normal cable lengths, as shown in Fig.2.3.

Fig.2.3 shows the output voltage for the 4% distortion level of the signal, versus frequency, with cable capacitance as a parameter. Output voltages below the lines given will produce less than 4% distortion.

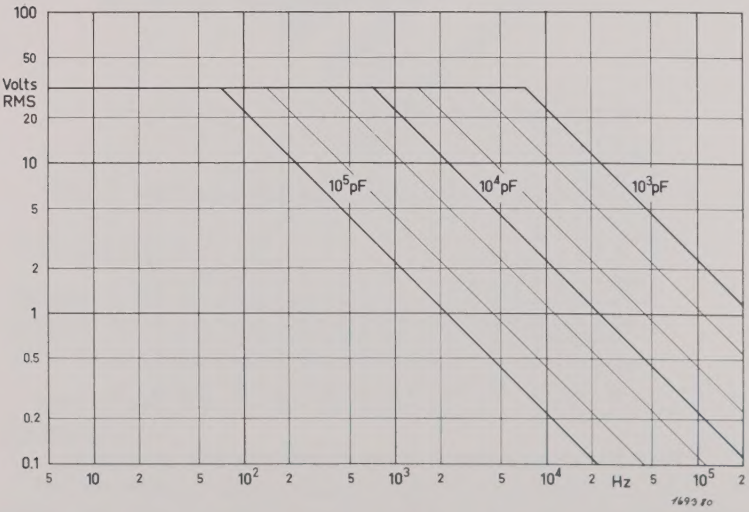

Fig.2.3. Limitations to the dynamic range of the preamplifier due to capacitive loading.

2.4 FREQUENCY CHARACTERISTICS

The frequency characteristics of the preamplifier with 1/2" and 1" microphones are shown in Fig.2.4. The low frequency response depends on the capacitance connected across its input. Typical curves are shown in Fig.2.5.

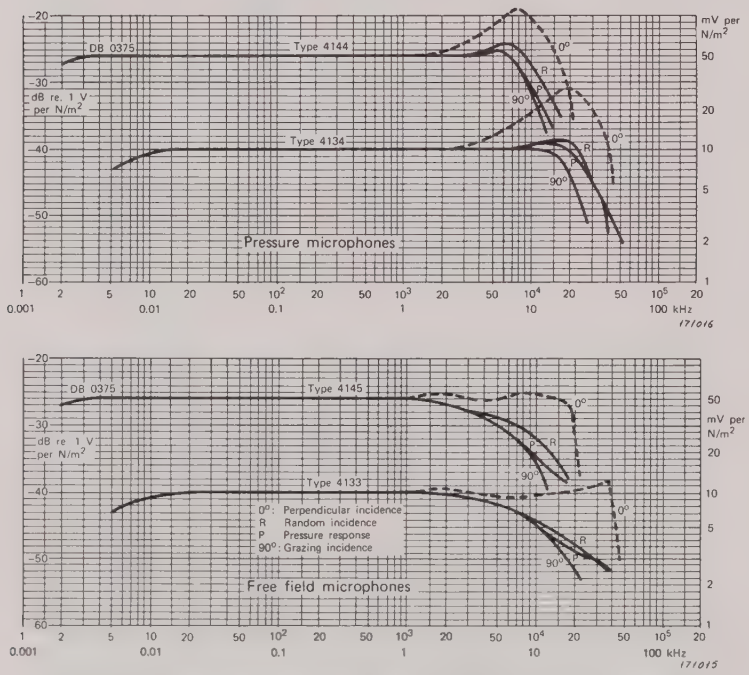

Fig.2.4. Frequency response with 1/2" and 1" microphones.

2.5 GAIN

The gain of the 2619 is approximately unity, or −0.02 to −0.1 dB.

2.6 DISTORTION

A typical distortion curve is shown in Fig.2.6. It shows the limit for 4% distortion. For normal operating conditions the distortion is less than 1%.

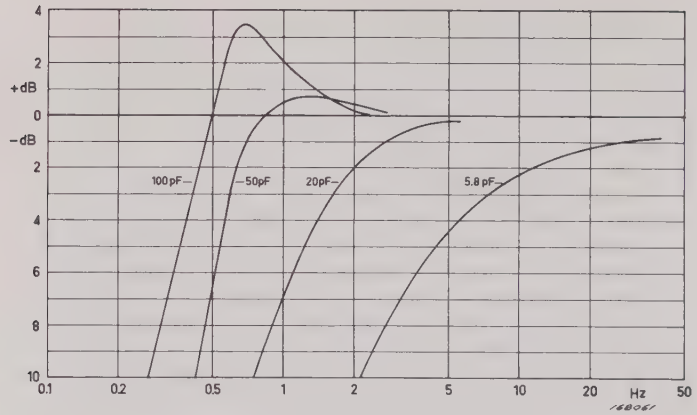

Fig.2.5. Typical low Frequency response

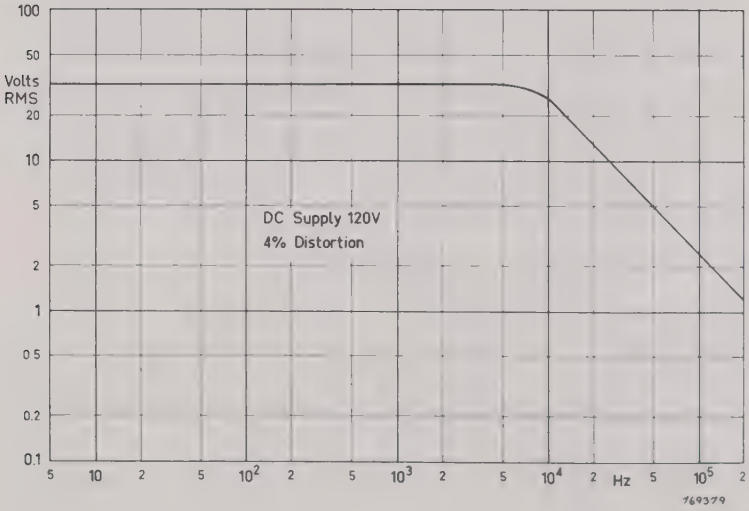

Fig.2.6. Maximum output voltage for 4% distortion.

2.7 NOISE

The self generated noise spectrum is shown in Fig.2.7 as a 1/3 octave analysis from 20 Hz to 40 kHz. Total noise in the wide band appears at the right hand end of the scale, shown weighted with A, B, C networks, and with a linear response 20 Hz—40 kHz.

2.8 TEMPERATURE ENVIRONMENT

The preamplifier operates satisfactorily in the temperature range —20 to + 60°C. With extension UA 0196 it is possible to keep the preamplifier in a cooler environment than the microphone, which can operate in temperatures of 150°C.

A heater coil is built into the microphone end of the preamplifier and prevents condensation in high humidity environments. This is automatically connected to the heater supply in ordinary B&K microphone input sockets. If, however, the microphones are used for extremely accurate measurements and calibration, or under circumstances where the temperature rise may cause problems, e.g. in contact with human skin, it is recommended that the heater be disconnected, or the goose-neck extension be used. Similar precautions must be taken when used in high temperature environments, over 60°C. When used in a battery driven set—up the heater should normally be disconnected.

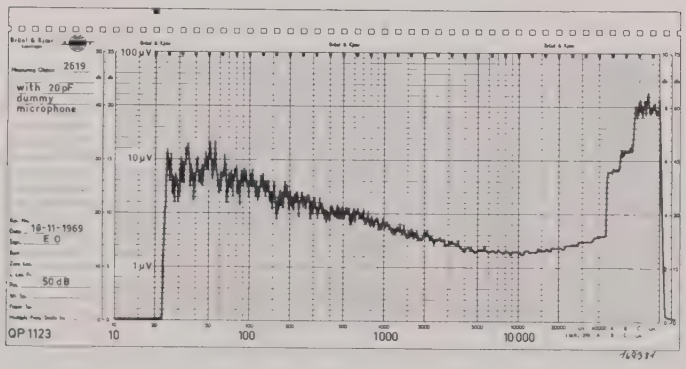

Fig.2.7. Noise spectrum. 1/3 octave analysis.

3. OPERATION

3.1 POWER SUPPLY

All the necessary power supplies are connected when the preamplifier is plugged into the CONDENSER MICROPHONE socket of one of the B&K Analysing Instruments, or microphone power supply. Normally 120 V DC is required, but it is possible to operate the 2619 from a single 28 V supply. The connections at the plug are shown in Fig.3.1. Pins 5 and 6 should be connected together for 28 V operation.

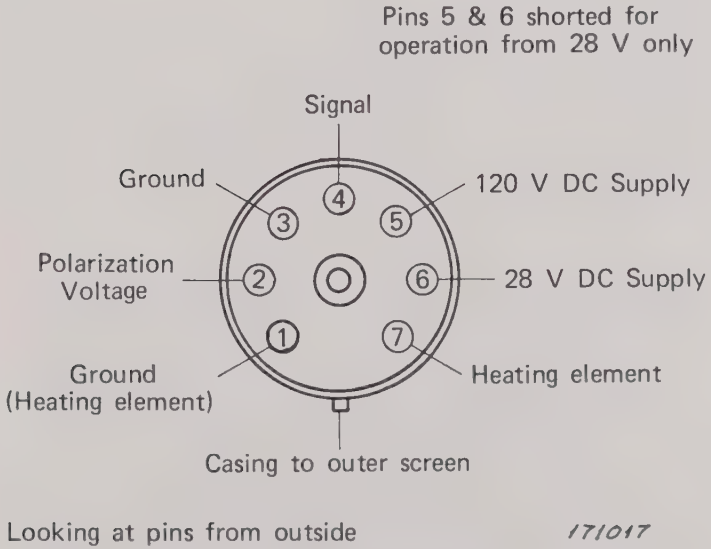

Fig.3.1. Pin connections.

If separate power supplies are used, a seven pin socket (JJ 0018) suitable for making connections to the plug can be obtained from B&K.

The heating element normally requires 6.3 V, and if used with a B&K spectrometer, microphone amplifier, or microphone power supply, this DC Voltage is provided. It can be left unconnected when using separate power supplies if there is no danger of condensation. If connected, the current through the heater should not exceed 100 mA.

If the very higest input impedance of the preamplifier is required, or for any reason the preamplifier is to be kept cool, the heater should not be used. The heater supply will be automatically connected when the preamplifier is plugged into a B&K spectrometer, amplifier, etc. So, in this case it must be disconnected. This is best done at the power supply of the instrument, and the service manual should be consulted to find out where the circuit can be broken.

3.2 MICROPHONES

The complete range of B&K microphone cartridges can be used with the 2619, except for the piezoelectric microphone 4117. The microphones and their respective adapters are:—

Microphone	Adapter
1"	DB 0375
1/2"	No adapter required
1/4"	UA 0035
1/8"	UA 0036

The nominal cartridge polarization voltage V_{pn} is 200 V, except for the 4148, where it is 28 V. If a polarisation voltage V_p different from V_{pn} is used, the sensitivity will change by approx. $20 \log \frac{V_p}{V_{pn}}$. For situations where only a single power supply is available (e.g. batteries in a field measurement set up) the polarisation voltage can be taken from the supply voltage by shorting pin 2 and 5. The sensitivity will then change as mentioned above.

The adapter JJ 2615 is provided for the connection of miniature cables, for example from an accelerometer, with socket Type NF 10—32 (B&K plugs VP 0012). This adapter contains a 50 pF capacitor to block the 200 V DC polarizing voltage required for the condenser microphones.

To provide the microphone with some directional flexibility, the flexible goose-neck extension is included. This also enables operation of the microphone in temperatures up to 150°C whilst the preamplifier is kept at its lower operating temperature of 60°C maximum.

The polarization voltage of the condenser microphone cartridge is supplied, in the 2619, through a long time—constant charging circuit. After switching on, or changing cartridges, several seconds should be allowed for the cartridge to charge up.

3.3 ACCELEROMETERS

The Type 2619 preamplifier can be used with any of the B&K accelerometers, with the adapter JJ 2615 for miniature cables.

The voltage sensitivity of the accelerometers, complete with cable, is given in the calibration chart supplied with each accelerometer. If a cable, different from the one used in the calibration, is employed, it must be remembered that the voltage sensitivity of the new accelerometer/cable combination will be different. The new sensitivity, S_v' is given by

$$Sv' = Sv \frac{(C_t + C_c)}{(C_t + C'_c)}$$

Where S_v is the calibrated sensitivity, with cable capacitance C_c connected, C_t is the accelerometer capacitance only, C_c' is the new cable capacitance.

3.4 OUTPUT

The output impedance is low ($\sim 25\,\Omega$) but the maximum peak current limits the high frequency response when capacitive loads are used (as shown in Fig.2.3), and this should be remembered when long extension cables are used between the preamplifier and analysing equipment. B&K extension cables Type AO 0027 and AO 0028/29, have capacitances of 100 pF/m and 57 pF/m respectively.

4. SPECIFICATIONS 2619

Supply voltage	120 V DC	28 V DC
Polarization voltage	200 V DC	200 V DC
Frequency range	2 Hz–200 kHz	3 Hz–200 kHz
Dynamic range with 1/2" microphone (5 dB above noise to 4% distortion)		
Linear 22.5 Hz–200 kHz	113 dB	95 dB
A weighted	128 dB	110 dB
B weighted	124 dB	106 dB
C weighted	115 dB	97 dB
Input resistance	$>$4000 MΩ	$>$2600 MΩ
Input capacitance	$<$0.8 pF	$<$1 pF
Output impedance	$<$25 Ω	$<$70 Ω
Attenuation (2619 alone)	$<$0.03 dB	$<$0.1 dB
Attenuation with 1/2" microphone	$<$0.35 dB	$<$0.45 dB
Current consumption, approx.	2 mA	1 mA

Noise (after 3 minutes):	with 1/2" microphone	with 1" microphone
Linear 22.5 Hz–200 kHz	40 μV	20 μV
A–weighted	7 μV	4 μV
B–weighted	11 μV	6 μV
C–weighted	30 μV	14 μV

Distortion, see curve inside
Pulse–rise time: 0.2 μsec
Decay time: 0.6 μsec
Temperature range: −20 to +60°C
Dimensions: 1/2" dia

Cable length: 2 m (6.6 feet)
Accessories Included: Adapter for 1" microphone (DB 0375), Coaxial input plug adapter for miniature cables (JJ 2615), Gooseneck UA 0196).

B & K INSTRUMENTS:

ACOUSTICAL....
Condenser Microphones
Piezo-Electric Microphones
Microphone Preamplifiers
Microphone Calibration Equip.
Sound Level Meters
(general purpose-precision-
and impulse)
Standing Wave Apparatus
Tapping Machines
Noise Limit Indicators

ELECTROACOUSTICAL....
Artificial Ears
Artificial Mouths
Artificial Mastoids
Hearing Aid Test Boxes
Telephone Measuring Equipment
Audiometer Calibrators
Audio Reproduction Test Equip.

STRAIN....
Strain Gauge Apparatus
Multipoint Panels
Automatic Selectors
Balancing Units

VIBRATION....
Accelerometers
Accelerometer Preamplifiers
Accelerometer Calibrators
Vibration Meters
Magnetic Transducers
Capacitive Transducers
Vibration Exciter Controls
Vibration Programmers
Vibration Signal Selectors
Mini-Shakers
Complex Modulus Apparatus
Stroboscopes

GENERATING....
Beat Frequency Oscillators
Random Noise Generators
Sine-Random Generators

MEASURING....
Measuring Amplifiers
Voltmeters
Deviation Bridges
Megohmmeters

ANALYZING....
Band-Pass Filter Sets
Frequency Spectrometers
Frequency Analyzers
Real-Time Analyzers
Slave Filters
Psophometer Filters
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RECORDING....
Level Recorders
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